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INHIBITIVE COMPOUND

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My present invention relates to metal cleaners and particularly to an assistant to alkaline baths for such purposes.

In the manufacture of articles from precious or semi-precious metals or their alloys, an important prerequisite to successful plating is an absolutely chemically clean surface free from all the fouling incidental to manufacture, including grease, dirt and excess soldering or polishing compound.

Among the standard types of cleaning compounds for use by electroplaters in preparing the work for plating, an alkaline cleaner has generally been found most satisfactory as providing the necessary saponifying, emulsifying and deflocculating actions needed to separate the dirt from the work, it being possible to adjust the alkalinity of pH value of the cleaner as desired. The articles to be cleansed sometimes have to be boiled in baths or solutions of such cleaners for several hours, and such cleansing bath must often receive a number and variety of manufactures as produced by any particular shop, and these may include a great variety of metals and alloys. Many of the alloys to be plated are of complex character, and may consist, for example, of gold and silver, gold and copper, gold and nickel, or copper, tin, zinc and nickel, which shows the problem from the metal factor. Many of these articles fabricated in whole or in part from these precious, semi-precious metals or their alloys present difficult problems on account of their composite character.

It has been noted in practice that certain alloys develop premature precipitative weaknesses by reason of which certain deposits unexpectedly form on the work. This may result from the partially spent or like condition of diminished activity or lag of the alkaline cleaner in its work or from some unknown reaction of the same with certain alloys.

It will be understood that the action of different baths with different metals produce some complex combinations in the bath after use for a few days. As some of these are of metallic source it is important to maintain them against premature precipitation and provide for their ultimate recovery after the bath is fully spent or has given reasonable service.

My present invention is based on research in the above art to provide means to compensate for the seeming failure of cleansers so that the work may continue without the necessity of throwing away the used bath after a few days, where weeks of service were expected and required for economical operation.

My problem resolved itself into (1) the reduction of the corrosion or dissolving of the different elements of the alloys to a minimum; and (2) the prevention of the dissolving metals from re-depositing on the undissolved metal.

I have attained my objective by providing a bath assistant which may be conveniently handled and easily added to the original cleansing solution by the ordinary attendants engaged on the cleaning work.

According to my concept of means of relief from these difficulties, I have provided for a compound basis in which there may be pointed out three factors:

(1) A retentivant in solution of the accumulated dissolved metal in the original bath. This must have the properties of a reducing agent, must be as non-corrosive as possible to metals, must be stable and form stable non-dissociated salts in the solution with the accumulated dissolved metals.

(2) A non-electrolyte which inhibits the corrosion and dissolving of the metal by deterrent interference with the electrolytic action of the acid on the metal.

(3) An alkaline cleaner such as a borate which prevents the inhibitor from forming on the metal surfaces and thus interfering with subsequent operations.

As cyanide dips are sometimes given an article in factory cleaning before putting the same into a gold or like plating bath, and the salts formed are convenient in process and recovery, I preferably use for a retentative or factor which acts to retain the dissolved materials in solution, a soluble cyanide as consistent with practice. This is preferably sodium or potassium cyanide or a mixture of the two. However, when it becomes necessary to boil a solution containing a cyanide and to hold in the boiling solution an article composed of an alloy, as referred to above, I find that the cyanide has a distinct corrosive action on the metal and that it tends to dissolve the individual component metals of the alloy at different rates, thus giving an irregular corroded surface to the material. The cyanide by itself, therefore, is not suitable for my purpose, but I have found that I can combine the cyanide with a colophony, such as is obtained from the residues of turpentine stills, and that this combination of cyanide (preferably sodium cyanide) with the colophony tends to minimize the corroding activity of the cyanide on the alloy. The colophony

is chemically mainly abietic acid and its anhydride ($C_{44}H_{62}O_4$). Acid anhydrides of this character probably form the sodium salt of abietic acid on boiling in alkaline solutions as it is well known that cyanides have a distinct attractive tendency to combine themselves with organic radicals which contain a double bond in their structure. Acids and acid anhydrides, such as abietic anhydride contain the double bond and are therefore chemically attractive to the sodium cyanide. My researches disclosed that when sodium cyanide in finely powdered condition is mixed with finely powdered colophony in an intimate mixture that a gradual reaction takes place between the two ingredients which causes them to combine in a friable brown compound which has the advantageous properties of the cyanide for my purpose with the corrosive metal tendency reduced to a minimum. This combination of the abietic anhydride and the sodium cyanide, which probably has the chemical formula $C_{44}H_{62}O_4CNNa$ is the material which constitutes the retentivant or means of retaining in solution of the accumulated dissolved metal in the original solution and which forms new complex organic substances. In this way my invention combines in a single compound the properties of keeping dissolved the above described metal factors in the solution and which I have designated as ingredient 1, and the non-electrolyte which inhibits, which I have designated as ingredient 2.

I preferably make a mixture of ingredient 1, ingredient 2 and ingredient 3. Such a mixture is characteristic of my inhibitive compound and I give as example the following formula:

Sodium cyanide (powdered)	6 ozs.
Colophony (finely ground resin)	3 lbs.
Borax (powdered)	11 lbs. 10 ozs.
Total	15 lbs.

After considerable experimentation, and the trial of a great many reagents and substances, I found that $\frac{1}{8}$ of an ounce of cyanide of soda per gallon would prevent the dissolved metal in the solution from reprecipitating on the undissolved metal or alloy. Less than this amount apparently will not prevent it from reprecipitating and therefore I indicate this as a minimum to be used in the solution under the given conditions.

Nevertheless, I found that the cyanide had a distinct corrosive tendency on the undissolved metals in the alloy. My concept is to provide in such an assistant an inhibitor or inhibitors which, when combined with the cyanide, will prevent its corrosive action and at the same time will not prevent the cyanide from itself acting as an inhibitor of the precipitation of the dissolved metal on the alloy.

After many experiments I found that ½ ounce to the gallon of the indicated colophony with $1\frac{15}{16}$ ounces to the gallon of borax were of high efficiency when combined with the cyanide for accomplishing this result.

The resulting compound, when added in an amount of 2½ ounces to the gallon of the cleaner in the tank will cause it to have a much longer life without any deleterious effect on the alloys to be cleaned. I therefore would suggest that my mixtures in accordance with my invention should be based closely on the above given formula, although it might obviously be modified as to proportions and the substitution of equivalent elements.

The formula above given therefore is intended to be illustrative only and instructive, but it represents nevertheless a characteristic balance to be preserved in such a compound as my own research indicated.

The ingredients indicated in the formula should be thoroughly mixed and allowed to age for at least a week. I find that they consolidate and react among themselves so that the material becomes a uniform mix. This should be broken up and added to any lagging bath at the rate of 2½ ounces to the gallon of cleanser when used for cleaning alloys containing gold or any of the metals involved in the plating art.

My assistant is primarily intended for use to supplement alkaline cleaners and is not intended to be used with acid cleaners.

I do not wish to confine myself to the particular metals or alloys named as any metallic articles which need to be cleaned to be given a finely polished and very clean surface may be cleaned by my mixture.

What I therefore claim and desire to secure by Letters Patent is:—

1. A cleaner-assistant for compensating premature lag in partially spent alkaline baths for articles of precious or like metals preparatory to being electroplated, consisting of a dry, intimate soluble mixture of an alkali metal cyanide salt, a non-electrolytic colophony inhibitive of corrosive action on the cleaned metal surfaces, and a powdered borate preventative of colophony attachment thereto.

2. A cleaner-assistant for restoring partially spent alkaline baths for articles of precious or like metals preparatory to being electroplated, consisting of a dry, intimate mixture of sodium cyanide, a finely ground colophony, and a powdered borate.

3. A cleaner for metals, alloys and the like, comprising an intimate mixture of sodium cyanide 6 ounces, finely ground colophony 3 pounds, and powdered borax 11 pounds 10 ounces, to a total of a 15 pound mix.

4. That method of improving the cleansing properties of an alkaline bath for articles of metal and metal alloys preparatory to plating and of preventing the reprecipitation on the cleansed surfaces of metals dissolved in said bath, consisting in adding to the bath sodium cyanide to keep the dissolved metals in solution, a colophony inhibitive of the corrosive action of the sodium cyanide on the metals and alloys, and a borate to prevent the colophony from attaching to the cleansed surfaces of the articles in the bath.

5. That method of improving the cleansing properties of an alkaline bath for articles of metal and metal alloys preparatory to plating and preventing the reprecipitation on the cleansed surfaces of the articles of metals dissolved in the bath, consisting in adding to the bath an effective amount of a prepared mixture of a cyanide salt, colophony and borax.

6. A compound for improving the cleansing properties of an alkaline bath for articles of metal and metal alloys preparatory to plating thereof and preventing reprecipitation of metals dissolved in said bath on the cleansed surfaces of said articles, comprising 6 ounces of sodium cyanide, 3 pounds of colophony, and 11 pounds 10 ounces of powdered borax to make a total of 15 pounds of compound mixture.

7. The method of claim 4 in which 2½ ounces of the mixture is added for each gallon of an alkaline cleanser solution.

8. A cleaner-assistant for restoring partially

spent alkaline baths for articles of precious or like metals preparatory to being electroplated, consisting of a mixture of potassium cyanide, colophony and a borate.

9. A cleaner-assistant for restoring partially spent alkaline baths for articles of precious or like metals preparatory to being electroplated, consisting of a mixture of an alkali metal cyanide salt, colophony and a borate.

10. A cleaner-assistant for restoring partially spent alkaline baths for articles of precious or like metals comprising a corrosive cyanide salt and colophony.

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